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author found, by forming galvanic circles with two different metals and an interposed acid, that when he used different kinds of acid, or varied the degree of their dilution, the electro-magnetic effects, as measured by a delicate galvanometer, bear no sort of relation to the conducting power of the fluid, as is assumed in the Voltaic hypothesis. He deduces the same conclusion from experiments made with an apparatus by which the fluid is confined in a rectangular box, divided by a membranous diaphragm into two compartments, so as to allow of the addition of an acid to the fluid contained in one of the compartments, and thereby limiting its action to one of the metallic surfaces. By means of another contrivance, the author ascertained that of two different metals, the one which, when acted upon by an acid, combines with the greatest quantity of oxygen, as measured by the volume of hydrogen disengaged, is always positive with respect to the other metal. Even two pieces of the same metal, differing in hardness, will be acted upon by the same acid in different degrees, and may thus be brought into different states of electricity. In general it is the harder of the two pieces of metal which becomes positive; but with steel the reverse obtains. It would appear, however, that with the same pairs of metallic discs, the direction of the electric current is determined by the nature of the acid employed: thus nitrous acid, acting upon zinc, copper, or iron, gives rise to a current in a direction opposite to the current which is produced by the sulphuric, nitric, or muriatic acids. Variations in the temperature of the metals will also occasion diversities in the results, not hitherto satisfactorily explained on any theory. From one experiment the author is led to infer that an acid is capable of combining with a pure metal, without the latter being previously reduced to the state of an oxide.

The Bakerian Lecture. On the Manufacture of Glass for Optical Purposes. By Michael Faraday, *Esq. F.R.S. &c.* Read November 19, December 3 and 10, 1829. [*Phil. Trans.* 1830, *p.* 1.]

As an introduction to his paper, the author gives a short account of the circumstances which have led to the present inquiry. He states the difficulties that exist in procuring glass sufficiently homogeneous to answer the purposes of the optician, and adverts to the efforts made by Guinand and by Fraunhofer to overcome them. As the art was still imperfectly known in this country, the President of the Royal Society in the year 1824 suggested the appointment of a committee, whose labours were facilitated by the Government removing the restrictions imposed by the excise laws to experiments on glass, and also undertaking to bear all the expenses of the inquiry, as long as it held out a reasonable expectation of ultimate success. An experimental glass-house was at first erected on the premises of Messrs. Pellatt and Green, at the Falcon Glass-works; but Mr. Faraday being unable to conduct them at that distance from his own residence, the President and Council of the Royal Society obtained leave of the President and Managers of the Royal Institution to erect another experimental furnace for continuing the investigation on their premises.

The author being intrusted with the immediate superintendence of the experimental part of the manufacture of the glass, conceives it to be his especial duty, at the present stage of the inquiry, to give an account of what has been done in his department; for although the investigation is still far from being completed, yet he trusts that a decided step has now been made in the manufacture of glass for optical purposes; and that it is due to the Society, as well as to the Government, to render an account of the results hitherto obtained.

The author begins this account by a statement of the usual defects incident to glass, which destroy the regularity of its action on light. These are, on the one hand, streaks, striæ, veins, and tails; and, on the other hand, minute bubbles; the former arising from the want of homogeneity, the latter from the intermixture of air. Of these, the first class of defects constitute the most serious evil, as they interfere with the rectilineal course of the rays of light while traversing the glass, while the latter are injurious merely from the interception of the rays, and their dispersion in all directions. The greater the difference in specific gravity of the ingredients of the glass, the greater is the tendency to form striæ when they are fused together; hence flint glass, which contains a large proportion of lead, is more liable to this defect than either crown- or plate-glass. After numerous trials of materials different from those which enter into the composition of the ordinary kinds of glass, borate of lead and silica were fixed upon as the most eligible, and as near an approximation as possible to a definite chemical union of their elements was aimed at, by taking single proportionals of each, and endeavouring to procure them, previous to combination, in the greatest possible state of purity. The oxide of lead was obtained from the nitrate of the metal previously crystallized. The boracic acid was also selected from the purest crystals afforded by the manufacturer, and carefully tested to ascertain its freedom from foreign matters. The silica employed was that of flint glass-maker's sand, obtained from the coast of Norfolk, and well washed and calcined, and freed from iron by nitric acid. It was then combined with protoxide of lead. These materials were then mixed in the proportions of 154·14 parts of nitrate of lead, 24 of silicate of lead, and 42 of crystallized boracic acid, and melted together in a separate furnace adapted expressly for this preliminary operation, and of which a minute description is given. A tray was then prepared of a thin lamina of platina, all the apertures of which were carefully closed by soldering, for containing the pulverized glass, which was to be subjected to the final melting in a furnace of peculiar construction, which the author terms the finishing furnace. After numerous trials of substances for constructing the chamber in which the fusion of the glass contained in the tray was to be conducted, recourse was had to the materials from which the Cornish crucibles are manufactured, and which were obtained through the kindness of the

President, and were expressly manufactured for the purpose by Mr. Mitchell, of Caleneck in Cornwall. In order to prevent the reduction of any portion of the lead entering into the composition of the glass, a current of fresh air was introduced by a tube, and made to pass along the surface of the fused glass. A very minute and circumstantial account is given of all the manipulations necessary for conducting these processes in all their stages; in some of which, however, the best methods of proceeding still remain to be ascertained, variations having been made up to the very last experiment, and it is only by still more extensive experience that the author expects the proper arrangements will ultimately be settled. Directions are given as to the occasional inspection of the glass during the process, the mode of stirring by a rake of platina, and the plan devised by the author of accelerating the disengagement and escape of bubbles, by throwing into the melted materials a quantity of pulverized platina, mixed with fragments of the same kind of glass. The glass which has been obtained by the mixture of materials above mentioned, constituting silicated borate of lead, has a specific gravity of 5·44, and high refractive and dispersive powers, and perhaps also very considerable reflecting power.—It is softer than ordinary glass, but less liable to be tarnished by sulphureous vapours, as they commonly exist in the atmosphere; and also less acted upon by moisture than glass, in which potash enters as an ingredient; it is also a much more perfect electric than ordinary glass. An Appendix is subjoined, containing descriptions of the rough glass furnace, and the finishing furnace; and also directions for preparing the spongy platina employed by the author in the latter stage of the process, in order to promote the disengagement of bubbles.

Account of Levellings carried across the Isthmus of Panamá, to ascertain the relative Height of the Pacific Ocean at Panamá, and of the Atlantic at the mouth of the River Chagres; accompanied by Geographical and Topographical Notices of the Isthmus. By John Augustus Lloyd, *Esq. Communicated by Captain* Sabine, *Sec. R.S.* Read November 26, 1829. [*Phil. Trans.* 1830, *p.* 59.]

The author having received from General Bolivar a special commission to survey the Isthmus of Panamá, with the view of ascertaining the most eligible line of communication between the two seas, arrived at Panamá in March 1828. Here he was joined by Captain Falmarc, a Swedish officer of Engineers, in the Colombian service. Anxious to lose no time in the prosecution of their objects, they proceeded on the 5th of May to commence their operations, resolving not to be deterred by the difficulties likely to arise from the rainy season, which had just set in, from personal privations, and even from the dangers to which they might expose their health. Their line of survey commenced at Panamá, and was continued along the old road to Porto Velo till it came to the bed of the Chagres, a river which falls into the Gulf of Mexico. The greatest height